

## CLAIMS

1. A method for manufacturing a relief material for seamless printing using a liquid-state photosensitive resin, comprising:

5       a setting step of setting a workpiece using either of a printing cylinder and a printing sleeve integrally supported by a metallic mandrel to holding rotating means for holding and rotating the workpiece;

          a supplying step of supplying a liquid-state  
10       photosensitive resin having a viscosity capable of holding an applying shape without being influenced by the gravity and centrifugal force due to rotation to a resin receiving plate which has a predetermined inclination and of which front end has a doctor blade shape by resin supplying means at a desired  
15       applied width in a linear mode;

          a molding step of molding the liquid-state photosensitive resin supplied to the resin receiving plate into a predetermined applied thickness by a front-end cutting edge of the resin receiving plate while rotating the workpiece and  
20       applying the resin to the outer periphery of the workpiece at a desired applied width; and

          an exposing step of forming a photosensitive resin cured layer by applying high-intensity ultraviolet light to the liquid-state photosensitive resin applied to the outer  
25       periphery of the workpiece while rotating the workpiece and thereby optically curing the liquid-state photosensitive resin so that it can be carved by an infrared laser beam.

2. The method for manufacturing a relief material for seamless printing according to claim 1, characterized in that at least one end of the resin receiving plate has a resin flow preventive movable dam linearly movable in the axis center  
5 direction of the workpiece.

3. The method for manufacturing a relief material for seamless printing according to claim 1, further comprising a shaping step of shaping the surface of the photosensitive resin cured layer.

10 4. The method for manufacturing a relief material for seamless printing according to claim 1, characterized in that the viscosity of the liquid-state photosensitive resin supplied in the supplying step ranges between 6 and 50kPa·s (both included) at 20°C and the ultraviolet light in the  
15 exposing step has a wavelength area of 200 to 400 nm and an ultraviolet intensity of 10mW/cm<sup>2</sup> or more.

5. The method for manufacturing a relief material for seamless printing according to any one of claims 1 to 4, characterized in that by linearly moving the resin supplying  
20 means in the axis center direction of the workpiece in the supplying step, either of first supply for supplying the liquid-state photosensitive resin housed in a resin vessel to the resin receiving plate in the linear mode and a second supply for supplying liquid-state photosensitive resin to the  
25 resin receiving plate from at least one or more resin supplying nozzles of the resin supplying means provided for the desired applied width is performed.

6. The method for manufacturing a relief material for seamless printing according to any one of claims 1 to 5, characterized by applying liquid-state photosensitive resin to the outer periphery of the workpiece at a desired thickness while gradually expanding the gap between the front-end cutting edge of the resin receiving plate and the outer periphery of the workpiece by moving the resin receiving plate vertically to the axis center of the workpiece in the molding step.

7. The method for manufacturing a relief material for seamless printing according to any one of claim 1 to 6, characterized by performing the treatment in the supplying step a plurality of times.

8. The method for manufacturing a relief material for seamless printing according to any one of claims 1 to 7, further comprising a first removing step for removing extra photosensitive resin cured layer optically cured by exceeding a desired width in the exposing step to a desired thickness in parallel with or after the shaping step.

9. The method for manufacturing a relief material for seamless printing according to any one of claims 1 to 8, further comprising a carving step for fusion-removing a photosensitive resin cured layer by rotating the workpiece while linearly-moving laser carving means for carving the photosensitive resin cured layer on the outer periphery of the workpiece in the axis center direction of the workpiece and focusing one or more infrared laser beams applied from the laser carving means on the photosensitive resin cured layer

in accordance with the control by a digital image recording signal after either of the shaping step and the first removing step.

10. The method for manufacturing a relief material for  
5 seamless printing according to claim 9, further comprising:

a second removing step for removing a photosensitive resin cured layer in an area in which formation of the relief image in the carving step is unnecessary to a desired thickness in parallel with or after the shaping step.

10 11. The method for manufacturing a relief material for seamless printing according to claim 10, characterized by laser-carving only a relief image forming area by performing interlaced scanning for moving the laser carving means at a high speed in the image unnecessary area in the carving step  
15 when the photosensitive resin cured layer in the area in which formation of the relief image is unnecessary is removed to a desired thickness in the second removing step.

12. The method for manufacturing a relief material for seamless printing according to anyone of claims 9 to 11, further  
20 comprising:

a cleaning step for cleaning the photosensitive resin cured layer by cleaning means for spraying cleaning fluid having a pressure between 0.2 and 30 MPa (both included) and a temperature between 40 and 140°C (both included) after any  
25 one of the carving step, removing step, and shaping step.

13. The method for manufacturing a relief material for seamless printing according to any one of claims 9 to 12, further comprising:

5 a post-exposing step for applying ultraviolet light to a relief image layer on the outer periphery of the workpiece while rotating the workpiece after either of the carving step and cleaning step.

14. The method for manufacturing a relief material for seamless printing according to claim 13, further comprising  
10 a surface modifying step for applying a surface modifying agent for modifying the surface of a relief image layer of the workpiece while rotating the workpiece to the relief image layer and drying the agent.

15. The method for manufacturing a relief material for seamless printing according to claim 14, characterized by performing forcible heating and drying while applying the surface modifying agent to the relief image layer in the surface modifying step.

16. An apparatus for manufacturing a relief material for  
20 seamless printing using a liquid-state photosensitive resin, comprising:

a workpiece continuous rotating mechanism having a structure capable of rotating by integrally connecting a workpiece to whose outer periphery the liquid-state  
25 photosensitive resin is applied;

a resin supplying mechanism according to any one of a first resin supplying mechanism having a resin supplying nozzle

integrated with a vessel for housing the liquid-state  
photosensitive resin and capable of linearly moving in the  
axis center direction of the workpiece, and a second resin  
supplying mechanism having at least one or more resin supplying  
5 nozzles in accordance with a desired applied width on a resin  
supplying header pipe-connected with the vessel for housing  
the liquid-state photosensitive resin;

a resin applying smoothing mechanism having a resin  
receiving plate whose front end has a doctor blade shape at  
10 a position facing the workpiece, having a structure which can  
linearly move in the direction vertical to the axis center  
of the workpiece and adjust a tilt angle; and

an exposing mechanism capable of applying high-intensity  
ultraviolet light to liquid-state photosensitive resin  
15 applied to the outer periphery of the workpiece and smoothed  
and linearly moving the applying means in the direction  
vertical to the axis center of the workpiece.

17. The apparatus for manufacturing a relief material  
for seamless printing according to claim 16, characterized  
20 in that the resin receiving plate has a resin flow preventive  
movable dam capable of linearly moving in the axis center  
direction of the workpiece at at least one end.

18. The apparatus for manufacturing a relief material  
for seamless printing according to claim 16 or 17, further  
25 comprising a working-tool holding pedestal mechanism capable  
of linearly moving a working-tool holding pedestal in the axis  
center direction of the workpiece, and at least one of a cutting

mechanism, grinding mechanism, and polishing mechanism capable of linearly moving the working tool fixed by the holding pedestal in the direction vertical to the axis center of the workpiece.

5        19. The apparatus for manufacturing a relief material for seamless printing according to claim 16 or 18, characterized by further setting a moving-position detecting mechanism capable of detecting a moving position at the time of the linear movement to at least one of the resin supplying  
10 mechanism, resin applying smoothing mechanism, exposing mechanism, working-tool holding pedestal mechanism, cutting mechanism, grinding mechanism, and polishing mechanism.

20. The apparatus for manufacturing a relief material for seamless printing according to any one of claims 16 to  
15 19, further comprising a rotation control mechanism for controlling a rotational position and circumferential speed of the workpiece by detecting the rotation angle of the workpiece.

21. The apparatus for manufacturing a relief material  
20 for seamless printing according to any one of claims 16 to 20, characterized in that the first resin supplying mechanism is a resin supplying mechanism according to either of a dispenser system and a syringe system respectively having a constant quantity supplying characteristic for unit time and  
25 a vessel for housing the liquid-state photosensitive resin is either of a bellows-type cartridge vessel and a back-lid push-to-connect-type cartridge vessel.

22. The apparatus for manufacturing a relief material for seamless printing according to any one of claims 16 to 21, characterized in that the second resin supplying mechanism is a resin supplying nozzle having at least one or more resin  
5 supplying cutting-off control mechanisms connected with either of a housing vessel having resin moving means for moving liquid-state photosensitive resin and a storing apparatus and the resin supplying means is a constant-quantity pressure pump having a constant-quantity supplying characteristic for unit  
10 time and a mechanism for removing bubbles in the liquid-state photosensitive resin is further set between either of the housing vessel and the storing apparatus and the resin supplying nozzle.

23. The apparatus for manufacturing a relief material  
15 for seamless printing according to any one of claims 16 to 22, further comprising:

a signal converting mechanism for receiving and storing a digital image recording signal and converting the stored signal into a light-modulation control signal of an infrared  
20 laser beam;

a laser generating mechanism for generating one or more infrared laser beams;

a control mechanism for independently setting the infrared intensity and applying time every infrared laser beam;  
25 and

a laser carving head mechanism having optical system means fixed by the holding pedestal to focus the infrared laser beam



on the surface of a photosensitive resin cured layer obtained by curing liquid-state photosensitive resin on the outer periphery of the workpiece.

24. The apparatus for manufacturing a relief material  
5 for seamless printing according to any one of claims 16 to 23, further comprising:

either of a water-jet cleaning unit and a hot-water high-pressure cleaning unit for cleaning a relief image laser-carved on the photosensitive resin cured layer by the  
10 infrared laser beam.

25. The apparatus for manufacturing a relief material for seamless printing according to claim 23 or 24, further comprising:

a surface modifying mechanism for spraying or applying  
15 a surface modifying agent for modifying the surface of a laser-carved relief image to the relief image.

26. The apparatus for manufacturing a relief material for seamless printing according to claim 25, further comprising:

20 a heating mechanism for forcibly heating and drying the surface modifying agent applied to the relief image by the surface modifying mechanism.